

WHAT IS CLAIMED IS:

1. A lithographic method for forming a pattern in a film carried on a substrate, comprising the steps of:

5                   depositing a film on a substrate to provide a mold having a protruding feature and a recess formed thereby, the feature and the recess having a shape forming a mold pattern;

10                  urging the mold into the film whereby the thickness of the film under the protruding feature is reduced and a thin region is formed in the film;

15                  removing the mold from the film;

                        processing the relief whereby the thin region is removed exposing a portion of the surface of the substrate which underlies the thin region; and

20                  15 whereby the exposed portion of the surface of the substrate substantially replicates the mold pattern,

                        the improvement comprising at least a portion of said protruding feature and a portion of said release have bonded thereto a release material comprising an inorganic linking group bonded to a molecular chain having release properties.

25                  20 2. The method of claim 1 wherein said release material comprises a material having the formula:

                        RELEASE-M(X)<sub>n-1</sub>-

                        or

25                  RELEASE-M(OR)<sub>n-1</sub>-, wherein

                        RELEASE is a molecular chain of from 4 to 20 atoms in length, preferably from 6 to 16 atoms in length, which molecule has either polar or non-polar properties;

30                  30 M is a metal or semimetal atom;

                        X is halogen or cyano, especially Cl, F, or Br;

                        R is hydrogen, alkyl or phenyl, preferably hydrogen or alkyl of 1 to 4 carbon atoms; and;

                        (n) is the valence -1 of M.

3. The process of claim 2 wherein RELEASE comprises a highly fluorinated organic group.

5 4. The process of claim 3 wherein said highly fluorinated group comprises a perfluorinated alkyl group.

10 5. The process of claim 2 wherein M is Si.

10 6. The process of claim 2 wherein X is halogen.

10 7. The process of claim 2 wherein X is chloro or bromo.

15 8. The process of claim 6 wherein M is Si.

15 9. The process of claim 7 wherein M is Si.

20 10. A process for improving the release properties of a surface comprising:

20 a) providing a surface;

20 b) contacting that surface with a release forming material wherein said release forming material comprises a material having the formula:

20 RELEASE-M(X)<sub>n-1</sub>-

25 or

25 RELEASE-M(OR)<sub>n-1</sub>-, wherein

30 RELEASE is a molecular chain of from 4 to 20 atoms in length, preferably from 6 to 16 atoms in length, which molecule has either polar or non-polar properties;

30 M is a metal or semimetal atom;

30 X is halogen or cyano, especially Cl, F, or Br;

30 R is hydrogen, alkyl or phenyl, preferably hydrogen or alkyl of 1 to 4 carbon atoms; and;

35 (n) is the valence -1 of M.



RELEASE is a molecular chain of from 4 to 20 atoms in length, preferably from 6 to 16 atoms in length, which molecule has either polar or non-polar properties;

5                   M is a metal or semimetal atom;

5                   X is halogen or cyano, especially Cl, F, or Br;

10                  R is hydrogen, alkyl or phenyl, preferably hydrogen or alkyl of 1 to 4 carbon atoms; and;

10                  (n) is the valence -1 of M,

10                  said material being bonded to said surface only through a bond directly to M

10                  where a group X or OR has been removed to enable bonding to said surface, with the group RELEASE still attached to M.

20. The surface of claim 19 wherein said material comprises a material of the formula:

15                  RELEASE-M(X)<sub>n-1</sub>-

15                  wherein

20                  RELEASE is a molecular chain of from 4 to 20 atoms in length, preferably from 6 to 16 atoms in length, which molecule has either polar or non-polar properties;

20                  M is a metal or semimetal atom;

20                  X is halogen or cyano, especially Cl, F, or Br; and

20                  (n) is the valence -1 of M.

25                  21. The surface of claim 20 wherein RELEASE comprises a highly fluorinated group.

25                  22. The surface of claim 21 wherein said highly fluorinated group comprises a perfluorinated group.

30                  23. The surface of claim 22 wherein said highly fluorinated group comprises a perfluorinated group of from 4 to 16 carbon atoms.

35                  24. The surface of claim 20 wherein M is Si.

25. The surface of claim 21 wherein M is Si.

26. The surface of claim 22 wherein M is Si.

5 27. The surface of claim 23 wherein M is Si.

28. A surface having good antiadherent properties comprising a surface having bonded thereto the material of the formula:

### RELEASE-M(X)<sub>p-2</sub>

10 or

RELEASE-M(OR)<sub>p-2</sub>, wherein

RELEASE is a molecular chain of from 4 to 20 atoms in length, preferably from 6 to 16 atoms in length, which molecule has either polar or non-polar properties;

M is a metal or semimetal atom;

X is halogen or cyano, especially Cl, F, or Br;

R is hydrogen, alkyl or phenyl, preferably hydrogen or alkyl of 1 to 4 carbon atoms; and;

20 p is the valence of M,

said material being bonded to said surface only through a bond directly to M.

29                   The surface of claim 19 wherein the surface comprises a  
25                   patterned mold surface.

30. The method of claim 1 including heating the thin film to a temperature to allow sufficient softening of the film relative to the mold prior to the step of urging.

30 31. The method of claim 1 wherein the feature on the mold is formed from material selected from the group consisting of: semiconductors, dielectrics, metals, ceramics, polymers and their combination.

32. The surface of claim 19 wherein said surface comprises a material selected from the group consisting of: semiconductors, dielectrics, metals, ceramics, polymers and their combination.

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33. The method of claim 1 wherein the step of processing comprises reactive ion etching.

34. The method of claim 1 including repeating the steps of obtaining  
10 a mold, urging, removing, and processing to form a multilayered device.

35. The method of claim 9 wherein the material is selected from the group consisting of semiconductors, dielectrics, metals, ceramics, polymers, and their combination.

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36. A lithographic method for forming a pattern in a film carried on a substrate, comprising the steps of:

obtaining a substrate having a release coating thereon formed by  
20 the reaction of a compound of the formula

RELEASE-M(X)<sub>n-1</sub>-

or

RELEASE-M(OR)<sub>n-1</sub>-, wherein

25 RELEASE is a molecular chain of from 4 to 20 atoms in length, preferably from 6 to 16 atoms in length, which molecule has either polar or non-polar properties;

M is a metal or semimetal atom;

X is halogen or cyano, especially Cl, F, or Br;

30 R is hydrogen, alkyl or phenyl, preferably hydrogen or alkyl of 1 to 4 carbon atoms; and;

(n) is the valence -1 of M,

depositing a film on the substrate;

obtaining a mold having a protruding feature and a recess formed thereby, the feature and the recess having a shape forming a mold pattern;  
urging the mold into the film creating a thickness contrast pattern in the film;  
removing the mold from the film; and  
transferring the thickness contrast pattern in the film onto the substrate.

37. A process for improving the release properties of a surface comprising:

10           a) providing a surface;

              b) contacting that surface with a release forming material  
              wherein said release forming material comprises a material  
              having the formula:

              RELEASE-M(X)<sub>n-m-1</sub> Q<sub>m</sub>,

15       RELEASE is a molecular chain of from 4 to 20 atoms in length, preferably from  
              6 to 16 atoms in length, which molecule has either polar or non-polar properties;

              M is a metal or semimetal atom;

              X is halogen or cyano, especially Cl, F, or Br;

              Q is a hydrogen or alkyl group,

20       m is the number of Q groups,

              n-m-1 is at least 1, and

              n is the valence -1 of M.

38. The process of claim 2 wherein said release material comprises a material  
25 having the formula:

RELEASE-M(X)<sub>n-1</sub>-

39. The surface of claim 28 wherein said release material comprises a material having the formula:

30 RELEASE-M(X)<sub>n-1</sub>.

40. The process of claim 38 wherein M is Si;  
X is halogen Cl or Br;  
RELEASE is perfluoroalkyl of  
and

n is 3.

41. The surface of claim 39 wherein M is Si;

X is halogen Cl or Br;

5 RELEASE is perfluoroalkyl of 6 to 20 carbon atoms

and

n is 3.

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